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**Abstract:**

This deliverable reports the dissemination actions undertaken by the CRUTIAL consortium during the first year as activities performed in workpackage WP6. The document also collects the list of publications produced so far.

Given the extremely high interest of different stakeholders involved in critical utilities in the topics addressed by CRUTIAL, and of the wider community from public authorities to European citizens which need to rely on resilient electricity supply system, dissemination is considered a prominent activity of the project. The results achieved during the project will help in designing and assessing resilient electric power and dedicated information infrastructures that will enable to reduce the frequency, duration and extent blackouts, and possible cyber threats by better mastering the various dimensions of interdependencies. This will clearly have a large social and economic impact.

**Keyword list:** Dissemination, Publications

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## Table of Contents

<b>1</b>	<b>INTRODUCTION</b> .....	<b>1</b>
<b>2</b>	<b>RELEVANCE OF CRUTIAL'S OBJECTIVES</b> .....	<b>2</b>
<b>3</b>	<b>DISSEMINATION ACTIONS</b> .....	<b>3</b>
3.1	PROJECT WEB SITE .....	4
3.2	DISSEMINATION TOWARDS ACADEMIA AND THE INTERESTED COMMUNITY AT LARGE .....	4
3.2.1	<i>Scientific Publications</i> .....	4
3.2.2	<i>Working groups related to dependability, security, power system control, power system security</i> .....	6
3.3	DISSEMINATION AND EXPLOITATION ACTIVITIES TOWARDS INDUSTRY .....	10
3.4	DISSEMINATION TOWARDS STANDARDIZATION BODIES .....	11
3.5	PROJECT'S TECHNICAL MEETINGS .....	12
3.6	THEMATIC WORKSHOP .....	12
3.7	FURTHER DISSEMINATION ACTIONS .....	12
<b>4</b>	<b>LIASON WITH OTHER PROJECTS AND PROGRAMS</b> .....	<b>13</b>
4.1	RELATED EUROPEAN PROJECTS .....	14
4.2	OTHER INITIATIVES .....	15
<b>5</b>	<b>COLLECTION OF PUBLICATIONS</b> .....	<b>17</b>
5.1	PUBLICATIONS EXPLICITLY ACKNOWLEDGING THE SUPPORT OF THE CRUTIAL PROJECT. 17	
5.2	PUBLICATIONS RELATED TO CRUTIAL ACTIVITIES BUT WITHOUT EXPLICIT ACKNOWLEDGEMENT TO CRUTIAL: .....	19
<b>6</b>	<b>CONCLUSIONS AND FUTURE PLANS</b> .....	<b>21</b>

## 1 INTRODUCTION

The project focuses on the electrical power infrastructure and the information infrastructures, by considering different topology realms and different kinds of risks: distinguishing the backbone from the specific information networks and from the infrastructures dedicated to the control and monitoring of the electric power infrastructure, as they usually have different levels of protection; distinguishing faults of different kinds and severities, such as electric power outages and cyber attacks.

The main objective of the project is the investigation of models and architectures that cope with the scenario of openness, heterogeneity and evolvability endured by electrical utilities infrastructures, in the present and near future. The approach taken should support the analysis and management of interdependencies and of the resulting overall operational risk.

Firstly, the project aims to develop comprehensive modeling approaches, supported by measurement based experiments, to analyze critical scenarios in which internal or external faults in a segment of the information infrastructure provoke a serious impact on the controlled electric power infrastructure. The goal is to understand and master such interdependencies to avoid escalating and cascading failures that result in outages and blackouts. The focus is on the modeling and analysis of interdependencies, especially considering various types of failures that can occur in the presence of accidental and malicious faults affecting the information and electric power infrastructures.

Given the complexity of the analysis task, a difficulty is to find the right abstractions of the models. The aim is therefore to produce, from conceptual analysis, generic models that can be refined and instantiated. It is planned to substantiate the abstractions by examples taken from the electric application domain. Another expected difficulty is the heterogeneity of the models, given the very different nature of the various components under study.

Secondly, the project intends to investigate distributed architectures dedicated to the control and management of the power grid, in the perspective of improving the capability of analyzing critical scenarios and designing dependable interconnected power control systems. The architectures under study addresses requirements coming from the needs of flexible electric power services, characterized by dispersed energy resources, on-demand control and generation-load variation from the market.

In consequence, the project's objective is to devise *new architectural configurations* that address the increase in operational risk derived from the analysis made above. This risk derives not only from accidental faults or wrong maneuvers, but also, and very importantly, from both the degree of vulnerability and the level of threat to which the infrastructures and services are subjected. The objective of preventing escalating failures on the various information infrastructures (monitoring, control, management) that interact on a decentralized power grid can only be met by the combined use of fault prevention and tolerance, and by the simultaneous addressing of accidental and malicious faults, also called intrusion-tolerance, enhanced by the provision of on-line monitoring support to evaluate possible alternative architectural configurations in uncertain and evolving scenarios.

If successful, the advanced solutions devised by CRUTIAL will constitute an important asset in the European technical arena, to be used by electrical utilities R&D, planning, and technology interface departments, to stimulate what we foresee as a dramatic improvement in the overall quality and resilience of electrical utilities infrastructures. Our foresight is that the take-up of these solutions will happen in coordination of the above-mentioned departments, with the several suppliers and providers involved: SCADA suppliers; information systems integrators; intranet/extranet/Internet service and infrastructure providers. The studies performed during the first year, and the preliminary results obtained so far, are promising towards reaching the expected advancements.

The structure of this deliverable is as follows. Section 2 recalls the CRUTIAL objectives and

discusses their relevance to the many different stakeholders in the electrical energy sector. The dissemination actions and means adopted by the CRUTIAL consortium are presented in Section 3, explicitly mentioning the specific dissemination effort undertaken during the first year. Liasons with related projects and programs are described in Section 4. The collection of publications, distinguished in publications explicitly acknowledging the support of CRUTIAL and those related but without acknowledgement, is included in Section 5. Conclusions and short indication of future dissemination and exploitation plans are drawn in Section 6.

## 2 RELEVANCE OF CRUTIAL'S OBJECTIVES

Electrical energy is a *crucial* cornerstone of the European society. The *CRUTIAL* project deals with the vulnerabilities related to the trend where Electric Power Systems and Information Infrastructures are becoming more closely intertwined. By modelling the involved interdependencies and developing architectural solutions for a more resilient system, it is crystal-clear that this project will have a strong influence on the architecture of future power transmission and distribution grids, that will allow to deal adequately with the trend towards the diversification of the power generation and power consumption into smaller units (*dispersed generation*). As a result of the CRUTIAL, one will have architectures that are *provably resilient*, supporting *survivability* of the service under a set of defined circumstances.

By introducing information infrastructure on a logical level on top of the electric power grid, one will be able to fully exploit these infrastructures for both dealing with timely gathering of information and consequently driving efficient countermeasures in case of disturbances (some of which may be fully or semi-automatic), as well as with business control systems for efficient day-by-day provision and usage of power energy. This is in-line with the introduction of commercial Intelligent Electronic Devices, deployed for the protection of citizens against failures (including cyber threats), and for supporting electric power management and control systems.

However, the introduction of such additional levels of information infrastructure will introduce a mutual interdependence between them and the electric power grid. Faults in such additional infrastructural levels may cause errors that propagate to a different level and/or interrupt part of the electric services. As electrical energy is a crucial cornerstone of the European society, it is important that potential faults and the resulting interdependencies are identified, studied, modelled and assessed in detail. CRUTIAL is centred around this better understanding.

Resilience has to be designed with respect to the logical level infrastructure and in connection to the interdependencies between it and the power grid. Also in this field there is heterogeneity of used techniques, based on special redundant power components at the power grid level and on different mechanisms at the logical level. What is not reported yet is a methodical in-depth study on such problems. CRUTIAL is devoted to modelling interdependent infrastructures taking into account multiple dimensions of interdependencies, in order to be representative. Furthermore, the definition of resilient architectural patterns of the dedicated information infrastructure must be based on the analysis and modelling of such interdependent infrastructures.

The results achieved during the project will help in designing and assessing resilient electric power and dedicated information infrastructures that will enable to reduce the frequency, duration and extent blackouts, and possible cyber threats by better mastering the various dimensions of interdependencies. This will clearly have a large social and economic impact. It is also expected that the approach undertaken by the project will be useful and applicable to other types of interdependent infrastructures.

Many different stakeholders will benefit from the CRUTIAL results:

- Electric utilities, industrial manufacturers, system integrators, etc., by designing a more resilient electric power infrastructure that benefits from dedicated information infrastructures;
- The electricity sector at large (incl. regulators), by knowing where vulnerabilities arise;
- Public authorities, by better coping with the risks associated to interdependent infrastructures;
- European citizens & industry, by continuing to enjoy the high reliability level of the electricity supply as seen in the last decades in Europe – in spite of many new evolutions in technologies and on the liberalised market.

### 3 DISSEMINATION ACTIONS

As underlined in the previous Section, CRUTIAL objectives are of high interest to a large sector of the population: in addition to specific stakeholders directly involved in critical utilities provisions and management, even the simple citizen would highly benefit from the project results. Therefore, the CRUTIAL activity plan includes a workpackage dedicated to disseminate project achievements and to define plans to exploit them. The partners are committed to actively promote dissemination and exploitation, at both academic and industrial level, as well as towards standardization bodies, through contacts and links they have already established and new ones to develop during the project lifetime. Moreover, the set-up of an Industrial Advisory Board constitute a further vehicle to spread project's results to a wider community.

Dissemination implies first of all cross-fertilization among the partners, so that they can benefit from one another's technical expertise and minimize the gap of the technical approaches and schemes that are worked on at different sites. The consortium integrates leading industrial and academic researchers from three critically important, but presently only weakly connected disciplines: i) electrical power generation, transportation and distribution ii) fault-tolerant and secure real-time systems and iii) modelling and evaluation of complex systems. All three disciplines are necessary in order to pursue a separately unachievable objective, and to develop innovative solutions to the challenging problem of resilience analysis, modelling and enhancement of interdependent information and controlled power infrastructures.

The composition of the consortium has been set to ensure a well balanced and a broad coverage of all the technical areas addressed in the project. It is composed of a major research company from the electro-energetic sector and academic institutions of internationally recognised expertise and experience in all the fields of interest to CRUTIAL: design and architecture of dependability, security, fault tolerance, stochastic modelling, experimental evaluation, and deep knowledge of the target infrastructures.

Dissemination activities have been already performed and are planned for the next two years in several directions. The major tools and channels used for dissemination during the project lifetime include:

- Project WWW-pages
- Workshops
- Scientific publications and conference presentations
- Publicity actions
- Promotion events by individual partners
- Liaison with other projects and programs
- Project meetings

- Others...

### 3.1 Project Web site

The project has established a web site <http://crutial.cesiricerca.it/> supported by the project partners and maintained by the coordinator, to provide a unified view of the project and to present CRUTIAL to the international community. The project WWW-pages serve as a means for continuous dissemination of information about the project for the public awareness as well as internally for the project participants. It is structured in two major areas: a public section and a private section. The public section offers general information on the project, including all public deliverables and other public documents produced in the framework of the project. Special attention is intended to be given to the quality of the WWW-pages and their frequent updating. The reserved area contains material accessible by project partners only, mainly working documents and any other material considered useful to the project partners. Two additional private web areas have been also set up: one reserved to the Industrial Advisory Board (IAB) members and the other for the European Commission. The IAB area allows to access some project presentations and documents (e.g., the material from the joint CRUTIAL & Cigré Session that was held in conjunction with the 2nd Technical Meeting in Leuven in May 2006). The EU area makes visible the material requested by the Commission, such as public and restricted project deliverables.

### 3.2 Dissemination towards academia and the interested community at large

The project teams disseminate relevant results to the academic communities via publication and presentation of papers in the major international conferences, workshops and working groups (related to dependability, security, power system control, power system security).

Academic partners take care of the dissemination of the project results also inside the university curricula and/or in PhD courses and doctoral schools.

#### 3.2.1 Scientific Publications

Dissemination of project's results through scientific publications (journals, magazines, conferences and workshops) in the field of dependability, security, power system control, power system security is undoubtedly an effective way to reach a wide community of both academic and industrial people interested in issues tackled by CRUTIAL. The project also disseminates the results towards the modeling and performance evaluation communities: indeed Electrical Power System Infrastructure is a rather new application field for these communities, and we expect that the interest raised by CRUTIAL papers will motivate more researchers to concentrate their efforts on the modeling of performance challenges opened up by CRUTIAL. The increasing spreading of online publications further favors the dissemination through this channel.

While journals and magazines are targeted at archival value contributions documenting research activities in specific areas, thematic conferences and workshops are particularly appealing channels for disseminating the project's results for two aspects:

- The short time between the submission of a paper and its publication in the conference/workshop proceedings. This favors quick dissemination of fresh research results
- The fruitful discussion that usually is triggered at the presentation of a paper to the conference/workshop, useful to consolidate and enhance the actual stage of the presented activities.

A list of Journals and magazines relevant for the CRUTIAL activities include:

- IEEE Transactions on Dependable and Secure Computing
- IEEE Transactions on Computers

- IEEE Transactions on Reliability
- IEEE Security & Privacy
- IEEE Transactions on Software Engineering
- IEEE transactions on instrumentation and measurement
- IEEE transactions on systems, man and cybernetics part C
- IEEE transactions on industrial electronics
- IEEE Internet Computing
- Computer Journal
- ACM Transactions on Information and System Security
- Performance Evaluation
- ACM SoSym ([Journal of Software and System Modeling](#))
- International Journal of Distributed Energy Resources
- Electra, the magazine addressed to the Cigré community
- International Journal of Critical Infrastructure (IJCIS): Interscience Publishers
- The Italian Association of Electrotechnical, Electronics, Automation, Information and Telecommunications (AEIT) Journal

**Commento [fd1]:** •  
International journal on critical infrastructures has been eliminated, since it looks a duplication

A list of conferences and workshops relevant for the CRUTIAL activities include:

- International Conference on Dependable Systems and Networks DSN
- European Dependable Computing Conference EDCC
- IEEE SRDS
- International Conference on Quantitative Evaluation of SysTems QEST
- ACSAC - Annual Computer Security Applications Conference
- ACM/IEEE International Conference on Model Driven Engineering Languages and Systems MoDELS (was previously called “UML conference”)
- IFIP WG 7.3 International Symposium on Computer Performance, Modeling, Measurements, and Evaluation – PERFORMANCE
- International Conference on Measurement and Modeling of Computer Systems - ACM SIGMETRICS
- IFIP SEC
- CRIS International Workshop on Critical Information Infrastructures
- Int. 3rd Int. Conf. on Critical Infrastructures CRIS
- Int. Workshop on Complex Network and Infrastructure Protection CNIP; ....
- International Workshop CRTES
- IEEE Int. Conf. on Systems, Man, and Cybernetics
- Conference on Security of Information Systems - Sécurité des Systèmes d'Information (SSI)
- European Performance Engineering Workshop (EPEW)
- Modelling of Objects, Components, and Agents

- International Conference on Application of Concurrency to System Design
- The International Conference on Availability, Reliability and security (ARES)
- International Conference on Computer Safety, Reliability and Security (SAFECOMP)
- World Computer Congress (WCC)
- IEEE Workshop on Dependable Parallel, Distributed and Network-Centric Systems (DPDNS)
- Annual Reliability and Maintainability Symposium (RAMS)
- Power Systems Computation Conference
- IEEE PES general meeting
- IEEE PES Power Systems Conference & Exposition
- IEEE Instrumentation and Measurement Technology Conference
- European Conference on Power Electronics and Applications (EPE)

During this first year, a number of papers have been published or accepted for publication; the complete list is shown in Section 5.

### 3.2.2 Working groups related to dependability, security, power system control, power system security

#### **IFIP WG 10.4 on Dependable Computing and Fault Tolerance** <http://www.dependability.org>

The Working Group 10.4 of IFIP was established by the IFIP General Assembly in October 1980, and operates under IFIP Technical Committee TC-10, "Computer Systems Technology". The charter of WG 10.4 (established 1980, revised 1988) states the aim and the scope of this Working Group as follows:

Increasingly, individuals and organizations are developing or procuring sophisticated computing systems on whose services they need to place great reliance. In differing circumstances, the focus will be on differing properties of such services -- e.g., continuity, performance, real-time response, ability to avoid catastrophic failures, prevention of deliberate privacy intrusions. The notion of dependability, defined as the trustworthiness of a computing system which allows reliance to be justifiably placed on the service it delivers, enables these various concerns to be subsumed within a single conceptual framework. Dependability thus includes as special cases such attributes as reliability, availability, safety, security. The Working Group is aimed at identifying and integrating approaches, methods and techniques for specifying, designing, building, assessing, validating, operating and maintaining computer systems which should exhibit some or all of these attributes.

Specifically, the Working Group is concerned with progress in:

- Understanding of faults (accidental faults, be physical, design-induced, originating from human interaction; intentional faults) and their effects.
- Specification and design methods for dependability.
- Methods for error detection and processing, and for fault treatment.
- Validation (testing, verification, evaluation) and design for testability and verifiability.
- Assessing dependability through modeling and measurement.

The main goal of WG 10.4 meetings is to conduct in-depth discussions of important technical topics under the form of Workshops focusing on selected key topics. A workshop on Critical Infrastructure Protection is the main feature of the meeting to be held in January 2007.

**Commento [fd2]:** At the end of each WG description, it should be indicated which partners of CRUTIAL are involved, if any

**Commento [fd3]:** Additional suggestion by Moohamed: to mention the presentations related to CRUTIAL that were given in the context of the corresponding WGs. So, please add them, if any

Jean-Claude Laprie gave a presentation related to CRUTIAL on the modelling of outages in Interdependent Critical Infrastructures at the IFIP WG 10.4 50th meeting held at Annapolis, Maryland, USA, end of June 2006. At the same meeting, Felicita Di Giandomenico gave an overview of the CRUTIAL challenges and objectives.

Participants from LAAS, FCUL and ISTI-CNR are members of the IFIP WG 10.4.

**IFIP Special Interest Group on Dependability Benchmarking**

[http://www.laas.fr/~kanoun/ifip\\_wg\\_10\\_4\\_sigdeb/](http://www.laas.fr/~kanoun/ifip_wg_10_4_sigdeb/)

Established by the IFIP WG10.4 in Summer 1999, this IFIG Special Interest Group promotes the research, practice, and adoption of benchmarks for computer-related system dependability.

In particular, the following areas are considered to be "in scope":

- Exchanging ideas about dependability benchmarking among researchers and practitioners (including participants from universities, industry, and government agencies).
- Documenting the state of the art for dependability measurement and benchmarking
- Create lists of issues that must be resolved to advance dependability benchmarking to a mature science
- Eventually, propose a mechanism and agenda for a group to propose
- As appropriate, create collaborative publications. A potential goal is to create a White Paper on dependability benchmarking as the result of this SIG's efforts.

Karama Kanoun from LAAS, a participant to CRUTIAL, is the chair of SIGDeB.

**IEEE TC on Dependable Computing and Fault Tolerance** <http://www.dependability.org/tc/>

The purpose of the Technical Committee (as espoused in its charter) is

- Provide a forum for exchange of ideas among interested practitioners, researchers, developers, maintainers, users and students in the technical field. The goal is to promote the identification and integration of approaches, methods, and techniques for specifying, designing, building, assessing, validating, operating, and maintaining computer systems in which faults are considered as natural, anticipated events, and thus, can be tolerated. A wide variety of faults are considered, including accidental faults (physical, design-induced, or originating from human interaction) and intentional faults. Specifically, the TC is concerned with progress in:
  - the understanding of faults and their effects,
  - specification and design methods for fault-tolerant computing,
  - validation, and design for testability and verifiability, and
  - assessment, through modeling and measurement, of dependability achieved.

In these ways, the TC hopes to play a crucial role in minimizing the risks that the increasingly sophisticated computing and communications systems might cause for society.

- Promote and facilitate the sharing of ideas, techniques, standards, and experiences between TC members for more effective use of technology.
- Conduct workshops, conferences, and other meetings to advance both the state-of-the-art and the state-of-the-practice in the technical area. This includes sponsoring the International Conference on Dependable Systems and Networks (DSN), the

annual flagship activity of this TC, sponsoring annual workshops focusing on various aspects of fault-tolerant computing, and co-sponsoring relevant conferences organized by the IEEE Computer Society, the International Federation of Information Processing, and the Council of European Professional Informatics Societies.

- Publish and distribute among its members, and other IEEE-CS parties, newsletters, proceedings, standards proposals, and other appropriate material on a non-profit basis. Publish an electronic newsletter containing meeting reports, calls for papers, and news announcements.
- Provide professional development opportunities for members in the technical area and related technologies.
- Foster other activities for the advancement of the field and the interests of the TC membership within the scope of the TC's charge under the rules of the IEEE-CS, including cooperating with other groups in joint activities and projects.

Participants from LAAS, FCUL and ISTI-CNR are members of this TC. [

**Commento [fd4]:** Are CESI, KUL and CNIT members of this TC?

**IEEE Technical Council on Software Engineering** <http://www.tcse.org/>. The IEEE Technical Council on Software Engineering (TCSE) encourages the application of engineering methods and principles to the development of computer software, and works to increase professional knowledge of techniques, tools, and empirical data to improve software quality.

TCSE is involved in the myriad ways that software is designed, developed, managed, and maintained. The aim is i) to contribute to the members' professional expertise, and ii) to help advance software engineering research and practice.

The Software & Systems Engineering Standards Committee (S2ESC), one of TCSE's member committees, develops and manages IEEE software engineering standards, working under the IEEE-CS Standards Activities Board.

Other TCSE Committees (topical member groups, SIGs) bring together members worldwide to advance specialty areas within software engineering:

- Reverse Engineering and Reengineering
- Software Reliability Engineering
- Requirements Engineering
- Software Reuse
- Quantitative Methods
- Software Engineering Education
- Professional Practice

Karama Kanoun from LAAS, a participant to CRUTIAL, is a member of TCSE.

**IFIP TC 11 Security and Protection in Information Systems** <http://www.ifip.tu-graz.ac.at/TC11/>

IFIP Technical Committee on Security and Protection in Information Systems (IFIP TC11) has created in 2006 a new Working Group on Critical Infrastructure Protection (IFIP WG 11.10), chaired by Prof. Sujeet Shenoi (University of Tulsa, USA) and vice-chaired by Prof. Eric Goetz (Dartmouth College, USA). The principal aim of IFIP WG 11.10 is to weave science, technology and policy in developing and implementing sophisticated, yet practical, solutions that will help secure information, computer and network assets in the various critical infrastructure sectors. Information infrastructure protection efforts at all levels – local, regional, national and international – will be advanced by leveraging the WG 11.10 membership's strengths in sustained research and development, educational and outreach initiatives. A special session on critical information protection has been already organized by this WG in the context of the 2006 World Computer Congress (WCC-2006) during which Jean-Claude Laprie gave a presentation of preliminary models developed in the context of

CRUTIAL to describe typical failures characterizing interdependent infrastructures (i.e., cascading, escalating and common-cause failures).

Yves Deswarte from LAAS is member of IFIP TC11 (as IEEE CS representative).

**International Electrotechnical Commission – IEC** <http://www.iec.ch/>

IEC is an international standard organisation, which prepares and publishes international standards for all electrical, electronic and related technologies. These serve as a basis for national standardization and as references when drafting international tenders and contracts. Several IEC's Technical Committees (TCs) deal with the Critical Infrastructure issues.

The TC 65a/b/c produces standards for process control. The TC 65a is devoted to the system safety development process and its WG10 is writing a three-part international standard IEC 62443-1/2/3 on system and network security for industrial process measurement and control systems. The TC65c is working on communications in process control and started the Working Group 13 that is in charge of issuing a cybersecurity standard in Ethernet-based communications.

The TC 57 works with standards for control systems and system components, in collaboration with other organisations making important developments with respect to SCADA security, such as the American Gas Association (AGA), the Instrumentation, Systems and Automation Society (ISA) and NIST. It is composed of a relevant set of working groups, among them: telecontrol protocols, distribution automation, substation communication, application program interface for Energy Management Systems, communication for deregulated energy markets, interfaces for distribution management systems, interoperability, data and communication security. The WG 15 is specifically related to Data and Communication security and has published a white paper "IEC TC57 Security Standards for the Power System's Information Infrastructure – Beyond Simple Encryption".

**International Council on Large Electric Systems – CIGRÉ** <http://www.cigre.org/>

CIGRÉ includes several study committees (SCs), facilitating international exchange on knowledge in the electricity industry. At least three of these committee work with issues, which are related to Critical Infrastructure:

- SC B3 – Substations: includes adoption of technological advances in equipments and systems in order to improve reliability and availability.
- SC C2 – System Operation and Control: considers functionalities and assesses security in operation of Control systems.
- SC D2 – Information Systems and Telecommunication: monitors emerging technologies and focuses on security requirements in the ICT-related systems.

The aforementioned SCs convened in 2003 the Joint Working Group titled "Security for Information Systems and Intranets in Electric Power Systems" that produced a series of papers in the journal Electra for raising awareness in the sector. In summer 2006, the JWG D2/B3/C2-01 ended its activities and the new Working Group 22 within the SC D2" has been set up at the meeting held in Paris in August 2006. The new WG titles "Treatment of Information Security for Electric Power Utilities (EPU)" and will continue the work started by the previous JWG following three main discussion tracks:

- Security Management Frameworks
- Risk Assessment
- Security Technologies.

CESI RICERCA is member of D2.22, chairing the discussion on the Risk Assessment track.

**Process Control System Forum - PCSF** [www.pcsforum.org](http://www.pcsforum.org)

The PCSF is an open, collaborative, voluntary forum of international stakeholders from government; academia; industry users, owner/operators, and systems integrators; and the vendor community. Its main objective is to establish a Forum for the control systems community that is uniquely positioned to:

- Aggregate information about current organizations, their efforts, directions, and work product from across multiple sectors to increase visibility and reduce redundancy.
- Identify consensus cross-industry and cross-functional issues that require resolution, and determine a path and effort that is owned, traceable, and produces generally acceptable solutions.
- Cross-connect decision-makers from industry, government, vendors, and academia, in ways that promote increased understanding of requirements and opportunities for collaboration.
- Impact a broad portion of the control system community through procedures, methods, guidelines, best practices, and other resources, issued through organizations that participate in the PCSF.

The currently active PCSF WGs are the following:

Congress of Chairs Standards committee chairs coordinate to avoid duplicative or conflicting standards.

Control System Security Event Monitoring Detecting cyber attacks on DCS and SCADA systems that run the critical infrastructure.

SCADA Cyber Self-Assessment The goal of SCySAG is to enable the development and use of the best possible next generation of self administered tools and methodologies for the assessment of the cyber security readiness of the process control systems. These systems are used in manufacturing, industrial, energy, and utilities. Specifically, SCySAG will publish and publicize methodology and tool requirements information, as well as objective data about available tools and methodologies.

**IEEE SMC Technical Committee on Infrastructure Systems & Services** ([http://www.ieeesmc.org/technicalcommittess/tc\\_iss.html](http://www.ieeesmc.org/technicalcommittess/tc_iss.html)). The mission of the TC is to contribute from a variety of disciplines, each with a different perspective on infrastructure system complexity, to an emergent theory and toolkit for the design and management of networked utility and infrastructure systems as complex socio-technical systems. In other words, the TC strives to organize a scientific stage for confronting, combining and possibly integrating the social and physical perspectives on infrastructure networks, in such a way that the insights can be made available for practitioners in the infrastructure sectors and help them to achieve better quality and reliability of infrastructure bound services.

### **3.3 Dissemination and Exploitation activities towards industry**

The partners will actively promote dissemination events towards industrial partners they have close contacts and links with, including electric power utilities, transmission system operators, power generation and distribution companies, SCADA suppliers and industry stakeholders.

A further vehicle for dissemination of CRUTIAL's results will be the Industrial Advisory Board that the consortium plans to set up on the basis of active contacts, with the aim of establishing a group of advisors who will be informed about the project progress and will be invited to provide their feedbacks during the project lifetime. Actually, the IAB represents a

target audience for project dissemination activities, a source of inputs about the real needs and an evaluation team of project approaches and achievements.

The current members of the IAB are:

- SIEMENS
  - Claus Kern [Claus.Kern@siemens.com](mailto:Claus.Kern@siemens.com)
  - Michael Munzert [michael.munzert@siemens.com](mailto:michael.munzert@siemens.com)
- ScottishPower
  - Bill Fulton [Bill.Fulton@sppowersystems.com](mailto:Bill.Fulton@sppowersystems.com)
- EFACEC
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It is planned to have approximately one annual meeting with the IAB members, in occasion of plenary technical meetings and/or other relevant events, to promote tangible involvement and stimulate their feedbacks and advices.

The CRUTIAL consortium agrees on the importance of exploiting this channel for disseminating CRUTIAL results.

During this first year of the project, there has been the opportunity to co-locate the second plenary technical meeting of CRUTIAL with a meeting of the CIGRE' WG D2/B3/C3-01. It was in May 2006, in Leuven, Belgium. A special session was therefore planned in the agenda of the CRUTIAL technical meeting to this purpose. For the industrial side, 4 Cigré members (including the CRUTIAL coordinator, Dr. Dondossola) and 1 member of the Industrial Advisory Board attended the meeting. The Session was organised into an overview of the CRUTIAL project, followed by one presentation per each WP and by a final presentation by the Cigré Convenor. After the presentations there was a discussion about the opportunity of collaborating with JWG in the identification of further works to be suggested by the JWG Technical Brochure, currently under preparation.

Following the CRUTIAL/Cigré Session two Cigré members accepted to join the CRUTIAL IAB team.

Another invitation will be issued for the next 4th Technical Meeting planned at the end of February 2007.

### 3.4 Dissemination towards standardization bodies

Standards are a key driver in the development of engineering systems in general, and of the electric power sector in particular. However the current status of ICS security related standards is at its early stages. Intermediate set of guidelines and best-practices are becoming available and may be applied in the transitional period until appropriate standards will be complete. This is the approach in North America, with the leadership of institutions such as the North America Electric Reliability Council (NERC) and the USA's National Institute of Standards and Technology (NIST). Similar initiatives would be greatly desirable in Europe.

Therefore, standardisation bodies related to power control systems are one type of industrial community targeted by our dissemination actions. Partners already involved in working groups on standardization (like CESI, who is a member of CIGRE), will take the opportunity

of WG meetings for disseminating project results, and to understand the trends inside the community as useful feedback for the project.

Standardization bodies in the field of cyber security of power control systems will take advantage of CRUTIAL results. CESI commits to interact and disseminate CRUTIAL's results to the benefit of those standardization bodies through its direct participation to the already mentioned Cigré WG D2.22.

### 3.5 Project's technical meetings

Project meetings are the main events for internal dissemination within the project. In addition, they also serve as a tool for disseminating information within the partner organisations.

It has been agreed that partners in turn will host the project meetings. Until now 3 plenary meetings have been held:

1<sup>st</sup> Technical Meeting, February 22-23, Milan, hosted by CESI (it acted also as kick-off meeting)

2<sup>nd</sup> Technical Meeting, May 16-17, Leuven, hosted by KUL;

3<sup>rd</sup> Technical Meeting, October 16-17, Lisboa, hosted by FCUL.

All the three meetings have been well attended by all the partners, and have been very useful forums for creating a common project knowledge and view on the basis of the individual expertise of the participants, for discussing research directions in a coordinated and cooperative manner, for showing and discussing the advancements from the previous meeting and getting feedbacks for improvements/extensions. The agenda for the 1<sup>st</sup> and 3<sup>rd</sup> events have also included an Executive Board Meeting session, for discussing the major issues related with the implementation of the workplan.

### 3.6 Thematic workshop

The project participants will support the organisation of a thematic workshop, to showcase the research and technology solutions pioneered by the project. The involvement will be mainly in producing and presenting papers describing the CRUTIAL activities and results, by participating in the technical programme committee, chairing sessions, etc. To raise the attendance and thus increase the dissemination level of project results, such event, to be held during the second half of the project lifetime, is planned in conjunction with a relevant related conference and/or similar workshops run by related projects. Contributions will be solicited also from the community outside the project participants, especially from the involved members of the IAB, to promote fruitful cross fertilization. This event is planned during the second half of the project (presumably, at the beginning of the third year). Publicity to such an event will be promoted long in advance to reach the wider interested community.

### 3.7 Further dissemination actions

Presentations have been made by project members at the following events:

- G. Deconinck, "Opportunities for intelligent communication networks in distributed electricity generation", CRIS technical meeting (Critical Infrastructure Institute), CPRI (Central Power Research Institute), Bangalore, India, Feb. 14, 2006.
- G. Deconinck, "Bedreigingen voor security in de process industrie – conceptueel kader en trends," Agoria/TI-BIRA seminar on Security in de procesindustrie – meer dan hackers buitenhouden, Ter Elst, Edegem, 21 Feb. 2006 (in Dutch).
- Paulo Verissimo, NSF-US workshop on "Beyond SCADA: Networked Embedded Control Systems Planning Meeting", which took place in Washington DC on 14-15 March, 2006.

**Commento [fd5]:** Nuno, Paulo: what is the title of the presentation?

- Paulo Verissimo, “On resilience of modern critical infrastructures”, Joint EU-US workshop on “Large ICT-based Infrastructures and Interdependencies: Control, Safety, Security and Dependability”, which took place in Washington DC on 16-17 March, 2006.
- Giovanna Dondossola, SecurIST workshop - Integration of 'New' D4 Projects with SecurIST, held in Brussels on 22 March, 2006.
- Yves Deswarte, "Les systèmes de commande face à la malveillance: quelles solutions pour quelles menaces?", Seminar "La cyber-sécurité des systèmes de contrôle", Working Group SP99, ISA-France, Nice , 10-11 May, 2006 (in French).
- G. Deconinck, “Netwerkkoppelingen – niets dan voordelen !?,” Profibusdag 2006, Keynote lecture, Ter Elst, Edegem, 1 Jun. 2006 (in Dutch).
- Paulo Verissimo, “Security challenges in systems-of-embedded-systems”, at the Joint US-EU-TEKES workshop: Long Term Challenges in High Confidence Composable Embedded Systems, Helsinki, Finland, June 2006.
- Jean-Claude Laprie, "Modeling Outages in Independent Critical Infrastructure", IFIP WG 10.4 50th meeting, Annapolis, Maryland, USA, 28 June, 2 July, 2006.
- Jean-Claude Laprie, "Opening of the electricity market: an exacerbation of the interdependencies between the electricity and information infrastructures, 19th IFIP World Computer Congress (WCC-2006), Special Session on Critical Infrastructure Protection, Santiago, Chile, August 20-25, 2006.
- Giovanna Dondossola, “Presentation of CRUTIAL” CRIS (Critical Infrastructure Institute) Third International Conference on Critical Infrastructures, Panel Session on Critical Infrastructure Protection, which took place in Old Town Alexandria (Virginia, USA) on 24-27 September, 2006.
- Jean-Claude Laprie, "Dependability of Critical Infrastructures- Modeling interdependencies between the Electricity and Information Infrastructures", joint meeting between LAAS and JST-CRDS (JAPAN), LAAS-CNRS, October 23, 2006.
- Mohamed Kaaniche, "Presentation of CRUTIAL", joint meeting between LAAS and JST-CRDS (JAPAN), LAAS-CNRS, October 23, 2006.
- Anas Abou El Kalam, Yves Deswarte (invited speakers), "Access Control for Critical Infrastructures", VI International Congress on Secure telematic applications in national and international projects, november 22-24, 2006, Minsk.
- Jean-Claude Laprie, "Presentation of CRUTIAL", Networking Session on Resilient Infrastructures and Information Fusion for Security: Current approaches, challenges and future directions, IST Event 2006, 21-23 November 2006, Helsinki, Finland.

**Commento [fd6]:** Nuno, Paulo: what is the title of the presentation?

#### 4 LIASON WITH OTHER PROJECTS AND PROGRAMS

The project partners have also agreed to establish strong and fruitful links with other related international projects. In fact, vulnerability of critical infrastructure appears to be growing due to a number of factors, including growing demand, hectic transactions, growing number of stakeholders, high interconnection and interdependencies, complexity of control. Therefore, development of integrated interdisciplinary frameworks and related technologies for the provision of resilience, dependability and security in complex interconnected and heterogeneous communication networks and information infrastructures that underpin our economy and society is being prioritely promoted by research workprogramme, both at European and American levels.

The CRUTIAL consortium is aware of a number of related programmes/projects/initiatives, briefly presented in the following, and is committed to the cooperate with them to benefit of

reciprocal research advances in the targeted field of electrical power utilities and, more in general in the field of resilient and secure infrastructure systems. Cooperation will be mainly realized in terms of exchange of activity documents and participation to relevant events (such as thematic workshops organized by such projects).

#### 4.1 Related European Projects

Among the most relevant R&D project related with CRUTIAL there are those supported by the EU under the FP6-IST Programme Projects in the Strategic Objective *"Towards a global dependability and security framework"* (<http://cordis.europa.eu/ist/trust-security/projects.htm>) and listed in Table 1. They belong to the categories of Integrated Projects, Network of Excellence, Specific Targeted Research Projects and Coordination Actions.

Title	Type	Start date- End date	Website
<b>IRRIIS</b> – Integrated Risk Reduction of Information-based Infrastructure Systems	EU IP Project – Funded under FP 6	01/02/2006 31/01/2009	<a href="http://www.irriis.org/">http://www.irriis.org/</a>
<b>GRID</b> : a coordination action on ICT vulnerabilities of power systems and the relevant defence methodologies	EU CA Project – Funded under FP 6	01/01/2006 31/12/2007	<a href="http://grid.jrc.it/">http://grid.jrc.it/</a>
<b>CI2RCO</b> - Critical information infrastructure research coordination	EU CA Project – Funded under FP 6	01/03/2005 28/02/2007	<a href="http://www.ci2rco.org">http://www.ci2rco.org</a>
<b>ReSIST</b> - Resilience for survivability in IST	EU NoE Project – Funded under FP 6	01/01/2006 31/12/2009	<a href="http://www.laas.fr/RESIST">http://www.laas.fr/RESIST</a>
<b>SERENITY</b> : System Engineering for Security and Dependability	EU IP Project – Funded under FP 6	01/01/2006 31/12/2008	<a href="http://www.serenity-project.org">www.serenity-project.org</a>
<b>DESEREC</b> : Dependability and Security by Enhanced Reconfigurability	EU IP Project – Funded under FP 6	01/01/2006 31/12/2008	<a href="http://www.serenity-project.org">www.serenity-project.org</a>
<b>HIDENETS</b> - Highly DEpendable ip-based NETworks and Services	EU STREP Project – Funded under FP 6	01/01/2006 31/12/2008	<a href="http://www.hidenets.aau.dk">www.hidenets.aau.dk</a>
<b>ESFOR</b> -: European Security Forum for web services, software, and systems	EU CA Project – Funded under FP 6	01/11/2005 31/10/2007	<a href="http://www.esfors.org">www.esfors.org</a>
<b>SECURIST</b> - Security IST Projects Cluster Support	EU CA Project – Funded under FP 6	01/11/2004 31/10/2006	<a href="http://www.ist-securist.org">www.ist-securist.org</a>

**Table 1: EU projects related to CRUTIAL**

IRRIIS, GRID and CI2RCO are EU projects focusing on Critical Infrastructure Protection and therefore highly related to CRUTIAL.

The IRRIIS project aims at increasing the dependability and resilience of Large Complex Critical Infrastructures by introducing appropriate Middleware Improved Technology (MIT) based on Information and Communication Technology (ICT). The focus of the project is highly related to that of CRUTIAL, being on electricity and telecommunications and especially on the interdependencies between these infrastructures, analyzed through the development of a synthetic simulation environment (SYNTEX).

The objective of GRID is to achieve consensus at the European level on the key issues involved by power systems vulnerabilities and the relevant defence methodologies, in view of the challenges driven by the transformation of the European power infrastructure. GRID wants to assess the needs of the EU power sector on these issues and achieve consensus among stakeholders and R&D institutions, so as to establish a roadmap for collaborative

research in view of the forthcoming 7th framework programme. The focus is especially directed to: i) methods to assess reliability, security and risks affecting the power grid, and ii) management, control and protection schemes and the relevant architectures and devices.

The main objective of the CI2RCO project is to create and coordinate a European Taskforce to i) encourage a co-ordinated Europe-wide approach for research and development on Critical Information Infrastructure Protection (CIIP), and ii) to establish a European Research Area (ERA) on CIIP as part of the larger IST Strategic Objective to integrate and strengthen the ERA on Dependability and Security. CI2RCO will focus on activities across the EU-25 and ACC<sup>1</sup> that are essential to be carried out at European level and that require collaborative efforts involving the relevant players of research, research funding actors, policy-makers and CI-stakeholders. This is going to be accomplished by a set of coordination activities supporting the improvement of networking and coordination of national and European research policies, programmes and funding schemes.

The CRUTIAL consortium will promote fruitful cooperation with these projects, mainly in terms of exchange of activity documents and participation to relevant events (such as thematic workshops organized by these projects). There are already strong links by some CRUTIAL partners: KUL is a partner in the GRID project, and belongs to the advisory board of the CI2RCO project; CESI is a partner in the GRID project. Of course, they will act as a highly effective vehicle for cross-fertilization among related activities. Moreover, the CRUTIAL consortium is part of the "IRRIIS Interest Group".

The other EU projects listed in Table 1 do not focus on Critical Infrastructures Protection, but include it in a wider perspective embracing resiliency and security in ICT systems. There are already established links with some of these projects, mainly through the direct participations of CRUTIAL. In fact:

- FCUL is a partner in the ReSIST, HIDENETS, ESFORS and SECURIST projects;
- LAAS is a partner in the ReSIST and HIDENETS projects;
- Some members of the ISTI-CNR team are involved in the ReSIST and HIDENETS projects.

Also, it is worth mentioning the initiative undertaken by the Electricity Group of the "Energy production and distribution systems" Unit from DG Research, which reviewed the **European projects in the Electricity field**, by preparing a brochure presenting the **synopses of relevant projects in this area**, in view of the upcoming **7th Framework Programme**. CESI RICERCA contributed to this initiative by preparing the CRUTIAL synopsys to be included in this brochure.

## 4.2 Other initiatives

In Table 2, some other initiatives related to CRUTIAL are listed.

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<sup>1</sup> [ACC means: Acceding and Candidate Countries](#)

Title	Type	Start date- End date	Website
<b>PolSec</b> - Politiques de sécurité et contrôle d'accès pour les grandes infrastructures critiques	Collaborative research project between LAAS-CNRS and LIFO «Laboratoire d'Informatique Fondamentale d'Orléans», France	Jan 2006 Dec 2008	<a href="http://www2.laas.fr/PolSec/">http://www2.laas.fr/PolSec/</a>
<b>RDS</b> - Ricerca di Sistema	Italian Research Programme - Funded by the Italian Ministry of Industry, Trade and Crafts	Active since 2000	<a href="http://www.ricercadisistema.it/">http://www.ricercadisistema.it/</a>
<b>TCIP</b> : Trustworthy Cyber Infrastructure for the Power Grid	US project – Funded by NSF, Dep. of Energy and Dep. of Homeland Security	August 2005 August 2010	<a href="http://www.iti.uiuc.edu/tcip/">http://www.iti.uiuc.edu/tcip/</a>

**Table 2: Other initiatives related to CRUTIAL**

The Italian Research Programme RdS has been set-up within the frame of the Public Interest Energy and performs research and development activities aimed at improving the economics, security and quality of the Italian electric system. The objective is to devise solutions to practical problems, taking into account dynamic evolutions and sustaining the changes dictated by international agreements (Kyoto), and evaluating the scientific-technological progresses. From 2000 to 2005 CESI (Centro Elettrotecnico Sperimentale Italiano) had been appointed to manage the funds assigned to the projects and its personnel (now moved in CESI RICERCA) were deeply involved in the development of the research activities. This Research Programme is structured into projects co-participated by the major research operators in the electrical field and academics, whose results are made public in form of reports (in Italian) or published papers (in Italian and English). More than 70 universities and research centres were involved in Italy and abroad. The Programme covers a wide-scope area of research in power generation, transmission and distribution grids, renewable and dispersed energy sources, also considering the physical hazards and environmental impact of these installations. Of specific interest for CRUTIAL are the activities in the area of power system regulation, control and automation including new control criteria for the power grids, probabilistic approaches to static and dynamic security assessment in the preventive control, ICT security analysis methodologies and robust ICT architectures that support the design and operation of networked automation applications, menaced by both accidental and malicious ICT faults. Through the direct involvement of CESI RICERCA, the CRUTIAL consortium will be strongly connected with related RdS activities.

The TCIP NSF Cyber Trust Center is a US initiative created in August 2005 to address the challenge of how to protect the US power grid. TCIP is working to provide the fundamental science and technology needed to create an intelligent, adaptive power grid that can survive malicious adversaries, provide continuous delivery of power, and support dynamically varying trust requirements. The objective is to develop the necessary cyber building blocks and architecture, and the validation technology to quantify the amount of trust provided by the proposed approach. TCIP Focus Areas include: i) Reliable and Secure Computing Base; ii) Trustworthy Data Communications and Control; iii) Wide-area Trustworthy Information Exchange, and iv) Quantitative validation. Given the highly related objectives of the two projects, CRUTIAL will promote liason with TCIP. The upcoming workshop on Critical Infrastructure Protection organized by the IFIP WG 10.4, participated by members of both CRUTIAL and TCIP, will be a valuable opportunity for exchanging information on the ongoing activities.

The aim of PolSecis is to develop access control policies and models as well as protection mechanisms, including for authentication and authorization, that are well suited to address the challenges raised by large, open, heterogeneous and interdependent critical information infrastructures. In particular, these models and mechanisms should take into account the various organizations involved in the infrastructure and the various roles of the users

belonging to these organizations. These mechanisms should be able to enforce a global security policy, defined from the security policies of the various organisations. Through the direct participation of LAAS, the electric power infrastructures and the associated information and control infrastructures, such as those investigated in CRUTIAL, are used as an example in this project. Nevertheless, the objective is to develop security models and protection mechanisms that are also suitable to other application domains.

## 5 COLLECTION OF PUBLICATIONS

### 5.1 Publications explicitly acknowledging the support of the CRUTIAL project.

#### *Journals:*

- [1] Miguel Correia, Nuno Ferreira Neves, Paulo Veríssimo, "From Consensus to Atomic Broadcast: Time-Free Byzantine-Resistant Protocols without Signatures", *The Computer Journal*, Vol. 49, No. 1, pages 82-96, Oxford University Press, January 2006.
- [2] J. Sproston and S. Donatelli, "Backward Bisimulation in Markov Chain Model Checking", *IEEE Transactions on Software Engineering*, August 2006, vol.32, n. 8, pp.531-546.

#### *Conference Proceedings:*

- [3] G. Dondossola, G. Deconinck, F. Di Giandomenico, S. Donatelli, M. Kaâniche, P. Verissimo, "Critical Utility Infrastructural Resilience", *International Workshop on Research Directions for Security and Networking in Critical Real-Time and Embedded Systems (CRTES 06)*, San Jose (USA), 4 April 2006, 4 pages.
- [4] G. Dondossola, G. Deconinck, F. Di Giandomenico, S. Donatelli, M. Kaâniche, P. Verissimo, "Critical Utility Infrastructural Resilience", *Proc. Int. Workshop on Complex Network and Infrastructure Protection (CNIP-2006)*, Rome, Italy, 28-29 Mar. 2006, pp. 183-195. Also in PCSF Reference Library (<<https://www.pcsforum.org/library>>).
- [5] T. Rigole, K. Vanthournout, G. Deconinck, "Interdependencies between an Electric Power Infrastructure with Distributed Control, and the Underlying ICT Infrastructure", *Proc. Int. Workshop on Complex Network and Infrastructure Protection (CNIP-2006)*, Rome, Italy, 28-29 Mar. 2006, pp. 428-440.
- [6] T. Rigole, G. Deconinck, "A survey on modeling and simulation of interdependent critical infrastructures," *Proc. 3<sup>rd</sup> IEEE Benelux Young Researchers Symposium in Electrical Power Engineering*, Gent, Belgium, April 27-28, 2006; 9 pages
- [7] J.C. Laprie, K. Kanoun, M. Kaaniche, "Modelling cascading and escalating outages in Interdependent Critical Infrastructures", *Fast Abstract in Supplement of the International Conference on Dependable Systems and Networks (DSN)*, Philadelphia, USA, June 2006.
- [8] N. Ferreira Neves, "Locating File Processing Vulnerabilities", *Fast Abstract in Supplement of the International Conference on Dependable Systems and Networks (DSN)*, Philadelphia, USA, June 2006.
- [9] Nuno Ferreira Neves, João Antunes, Miguel Correia, Paulo Veríssimo, Rui Neves, "Using Attack Injection to Discover New Vulnerabilities", in *Proceedings of the International Conference on Dependable Systems and Networks (DSN)*, Philadelphia, USA, June 2006.
- [10] Henrique Moniz, Nuno Ferreira Neves, Miguel Correia, Paulo Veríssimo, "Randomized Intrusion-Tolerant Asynchronous Services", in *Proceedings of the International Conference on Dependable Systems and Networks (DSN)*, Philadelphia, USA, June 2006.

- [11] A.N.Bessani and M.Correia and J.S.Fraga and L.C.Lung. Sharing Memory between Byzantine Processes using Policy-Enforced Tuple Spaces. In Proceedings of the 26th International Conference on Distributed Computing Systems (ICDCS), July 2006.
- [12] Paulo Veríssimo, Nuno Ferreira Neves, Miguel Correia, CRUTIAL: The Blueprint of a Reference Critical Infrastructure Architecture, Proceedings of the 1st International Workshop on Critical Information Infrastructures Security (CRITIS), Samos Island, Greece, August 2006.
- [13] Bondavalli, S. Chiaradonna, P. Lollini, and F. Squittieri, "Integration of an MPS modeling approach into Möbius", 3rd International Conference on Quantitative Evaluation of SysTems (QEST 2006) - Tool Session, University of California, Riverside, CA, USA, September 2006.
- [14] M. Garetto, M. Gribaudo, "Performance analysis of delay tolerant networks with model checking techniques", 3rd International Conference on Quantitative Evaluation of SysTems (QEST 2006) - University of California, Riverside, CA, USA, September 11-14, 2006.
- [15] D. Cerotti, S. Donatelli, A. Horváth, J. Sproston, "CSL model checking for generalized stochastic Petri nets", 3rd International Conference on Quantitative Evaluation of SysTems (QEST 2006) - University of California, Riverside, CA, USA, September 11-14, 2006.
- [16] M. Beccuti, G. Franceschinis, S. Baarir, J.-M. Ilié "Efficient lumpability check in partially symmetric systems" 3rd International Conference on Quantitative Evaluation of SysTems (QEST 2006) - University of California, Riverside, CA, USA, September 11-14, 2006.
- [17] G. Dondossola, G. Deconinck, F. Di Giandomenico, S. Donatelli, M. Kaâniche, P. Verissimo, "An Approach to Modelling and Mitigating Infrastructure Interdependencies", Proc. 3rd Int. Conf. on Critical Infrastructures (CRIS-2006), Old Town Alexandria (VA), USA, September 25-27, 2006, 4 pages.
- [18] Alessandro Daidone, Felicita Di Giandomenico, Andrea Bondavalli, Silvano Chiaradonna, "Hidden Markov Models as a support for diagnosis: formalization of the problem and synthesis of the solution", in Proceedings 25th IEEE SRDS Conference, Leeds, UK, October 2006.
- [19] Henrique Moniz, Nuno Ferreira Neves, Miguel Correia, Paulo Veríssimo, Experimental Comparison of Local and Shared Coin Randomized Consensus Protocols, Proceedings of the 25th IEEE Symposium on Reliable Distributed Systems (SRDS), Leeds, UK, October 2006.
- [20] Paulo Sousa, Nuno Ferreira Neves, Paulo Veríssimo, William Sanders, Proactive Resilience Revisited: The Delicate Balance Between Resisting Intrusions and Remaining Available, Proceedings of the 25th IEEE Symposium on Reliable Distributed Systems (SRDS), Leeds, UK, October 2006
- [21] G. Deconinck, T. Rigole, K. Vanthournout, R. Tirtea, A. Dusa, J. Driesen, "Embedded automation for energy applications and its interdependence with the info'structure", Proc. 2006 IEEE Int. Conf. on Systems, Man, and Cybernetics, (special session: The security challenge of public information networks in operation of industrial systems and critical infrastructures), Taipei, Taiwan, 8-11 October 2006, pp. 575-579.
- [22] Eric Alata, V. Nicomette, M. Kaaniche and M. Dacier, "Lessons learned from the deployment of a high-interaction honeypot", Proc. Sixth European Dependable Computing Conference (EDCC-6), Coimbra, Portugal, October 18-20, 2006, IEEE Computer Society, pp. 39-44
- [23] Anas Abou El Kalam, Yves Deswarte, "Multi-OrBAC: a new access control model for distributed, heterogeneous and collaborative systems", 8th International Symposium On

Systems And Information Security (SSI'2006), 08-10 November 2006, Sao Jose Dos Campos, Sao Paulo, Brazil.

- [24] T. Rigole, K. Vanthournout, G. Deconinck, "Distributed control systems for electric power applications" *Proc. 2<sup>nd</sup> Int. Workshop on Networked Control Systems: Tolerant to Faults*, Rende (CS), Italy, 23-24 Nov. 2006, 7 pages.
- [25] T. Rigole, G. Deconinck, G. Dondossola, F. Garrone, C. Brasca, "Impact of ICT failures on distributed generation applications," *Proc. DIGESEC - CRIS workshop 2006 Influence of distributed generation and renewable generation on power system security*, Magdeburg, Germany, 6-8 Dec. 2006.
- [26] D. D'Aprile, S. Donatelli, A. Sangnier, J. Sproston. "From Time Petri Nets to Timed Automata: an Untimed Approach", accepted for publication at TACAS 2007 (13th. International Conference on tools and Algorithms for the Construction and Analysis of Systems).
- [27] S. Bernardi, J.' Merseguer, "A UML profile for dependability analysis of real-time embedded systems", accepted for publication at the Sixth International Workshop on Software and Performance, Buenos Aires, February 2007.
- [28] G. Dondossola, F. Garrone, J. Szanto, G. Fiorenza "Emerging information technology scenarios for the control and management of the distribution grid", to be published in the 19th International Conference and Exhibition on Electricity Distribution, Vienna, 21-24 May 2007.

## 5.2 Publications related to CRUTIAL activities but without explicit acknowledgement to CRUTIAL:

- [1] G. Dondossola, O.Lamquet, J. Szanto, "Sicurezza delle comunicazioni nei sistemi di controllo del sistema elettrico", The Italian Association of Electrotechnical, Electronics, Automation, Information and Telecommunications (AEIT) Journal, No. 1, pages 16-27, January/February 2006 (in Italian).
- [2] G. Dondossola, J. Szanto, M. Masera, I.N. Fovino, "Evaluation of the effects of intentional threats to power substation control systems", *Proc. Int. Workshop on Complex Network and Infrastructure Protection (CNIP-2006)*, Rome, Italy, 28-29 Mar. 2006, pp. 309-320. Also selected for publication on the Special Issue of the International Journal of Critical Infrastructures (IJCI).
- [3] M.Martinello, M. Kaaniche, K. Kanoun, Aguilar-Melchor, "Modeling user perceived unavailability due to long response times", 11th IEEE Workshop on Dependable Parallel, Distributed and Network-Centric Systems (DPDNS'06), Rhodes (Greece), 25-29 April 2006, pp. 163-183 □
- [4] S. Bernardi, J. Merseguer, "QoS assessment via Stochastic Analysis", *IEEE Internet Computing*, vol. 10(3), May 2006, pp. 32-42.
- [5] M. Martinello, M. Kaaniche, K. Kanoun, Modeling service availability in web clusters architectures, *Workshop on Fault Tolerant Computing (WTF'2006)*, Curitiba (Brésil), 29 May - 2 June, 2006, pp. 93-106.
- [6] A. Abou El Kalam, Y. Deswarte, "Multi-OrBAC: un modèle de contrôle d'accès pour les systèmes multi-organisationnels", *Third Conference on Security of Information Systems - Sécurité des Systèmes d'Information (SSI 2006)*, Seignosse (France), 6-9 June 2006 (in French).
- [7] A. Horváth, M. Telek Editors, "Formal Methods and Stochastic Models for Performance Evaluation", *Third European Performance Engineering Workshop, EPEW 2006*, Budapest, Hungary, June 21-22, 2006, Proceedings LNCS 4054, Springer.

- [8] D. Codetta-Raiteri, G. Franceschinis, M. Gribaudo, "Defining formalisms and models in the DrawNet modeling system", Workshop on Modelling of Objects, Components, and Agents, (MOCA2006), Turku, Finland, June 2006.
- [9] S. Donatelli and P.S. Thiagarajan Editors, "Proceedings of the 27<sup>th</sup> International Conference on Application and Theory of Petri Nets and Other Models of Concurrency", Turkey, Finland, June 26-30 2006, LNCS 4024, Springer.
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## 6 CONCLUSIONS AND FUTURE PLANS

This deliverable has discussed the major means and actions that the consortium has identified as effective and powerful to disseminate the project's achievements. A detailed description of the dissemination actions undertaken during the first year has then been included. They have mainly spanned along the following directions:

- Set up of a project web site, maintained by the coordinator with the support of the whole consortium, as a means for continuous dissemination of information about the project for the international community, as well as internally for the project participants;
- Set-up of the Industrial Advisory Board (IAB), with the aim of establishing a group of advisors who are informed about the project progress and are invited to provide their feedback during the project lifetime;
- Periodic project technical meetings, to promote internal dissemination and cross-fertilization among partners;
- Dissemination of project's results through scientific publications in the related fields of dependability, security, power system control, power system security. A significant number of publications have been already produced during the first year; the complete list is in Section 5;
- Dissemination through participation to Working Groups and national/international events related to dependability, security, power system control, power system security;
- Dissemination towards appropriate standardization bodies and industrial organizations, on the basis of active contacts by CRUTIAL partners;
- Establishment of contacts with related, currently active projects.

A thematic workshop is also planned, possibly in conjunction with a relevant related conference and/or similar workshop organized by related projects. This event, planned in a mature stage of the project lifetime (presumably, at the beginning of the third year) is intended as a highly productive opportunity to present and discuss CRUTIAL results to a wide community, to get valuable feedbacks and to establish synergic contacts.

The consortium also intends to address the educational sector, e.g. through the establishment of university curricula and/or PhD courses on themes related to CRUTIAL, and on training young people.

Table 3 provides an overview of the means adopted for the dissemination of knowledge.

All these activities will be continued, and even reinforced, during the next two years to assure prompt and wide spreading of CRUTIAL achievements towards enhancing the survivability of infrastructures for power generation and distribution and to provide guidelines to be pursued at global European level to try to uniform procedures and protocols.

The results that are expected from CRUTIAL can have a large impact on the way power generation, distribution and management will be carried out at European level. The new modelling methods and architectural solutions that will be offered are necessary for power infrastructures to cope with disrupting failures or cyber attacks. They will be to the possible extent "technology-neutral" and thus "vendor-independent", such that they can be taken-up and used by the European industry in general.

During the first year, the effort of the project concentrated on the identification and description of control system scenarios, and on the preliminary identification of directions for interdependencies modeling and architectural solutions. Given the still preliminary flavour of these research investigations, a concrete exploitation plan is not feasible at this early stage of the project, and it is postponed to a subsequent phase. However, in this first year specific

effort has been also devoted to involving industry in taking a role and evaluating the project achievements. In fact, on the basis of active contacts an Industrial Advisory Board has been set up, including representatives from utilities, operators and vendors. Exploitation of CRUTIAL knowledge is also expected to be performed through the IAB members, in addition to other individual partners contacts with relevant industrial sectors and standardization bodies. However, according to the current state of knowledge in the challenges addressed by the project, deep research investigations are still required before devising concrete, directly exploitable solutions.

Planned/actual date	Type	Type of audience <sup>2</sup>	Countries addressed	Partner responsible/involved
Set-up in February 2006 – continuously maintained	Project web site	Research, academic, industrials, standardization bodies, public authorities, ...	All the international community	CESI with the support of the whole consortium
Continuously during the project life	Publications	Research, academic, industrials	All the international community	ALL
Periodically during the project life	Project meetings	Project partners + IAB members (once per year)	Those of the project partners and IAB members	ALL
Continuously during the project life	Promotion events by individual partners	Research, academic, industrials, standardization bodies, public authorities, ...	All the international community	ALL
Continuously during the project life	Liason with related projects	Research, academic, industrials	EU, US	ALL
To advertise the planned thematic workshop	Posters/flyers	Research, academic, industrials	All the international community	CESI + ALL
Third year	Thematic workshop	Research, academic, industrials, standardization bodies, public authorities, ...	Mainly EU	CESI + ALL

**Table 3: Overview of the dissemination activities**

<sup>2</sup> Related to dependability, security, power system control, power system security, the electricity sector at large.